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COUNTRY: Belgium

SUBJECT: Institute Belgique de Haute Pressions

PLACE : Brussels

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SOURCE: US citizen, Ph.D. and professor of physics at a well-known US university. He is working under contract to the US military establishment in the field of physical metallurgy. In September 1952 he visited the Institute Belgique de Haute Pressions to compare techniques there with US work.

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1. At this laboratory (under the direction of Dr L Deffet) I saw three separate types of work of current interest.

(a) High Pressure Studies on Tubes Including Hysteresis Data and Bursting Pressures.

Drs L Lialine and J Gelbgras are doing this work. (Dr Gelbgas also belongs to the staff at the University of Brussels where he is investigating the melting point of pure substances at high pressures - for example, $CCl_4$ up to 6000 atmospheres). The high pressure studies on tubes were performed on materials such as mild steel, and nickel chrome steel (stainless steel). The dimensions of the tubing of mild steel, for example, were 33mm outside diameter and 12 mm inside diameter. On this mild steel tube the elastic range extends to about 1500 atmospheres on the first cycle and to about 2000 atmospheres on the second trial. With nickel-chrome-steel (stainless) having a ratio of diameters of 2.6 a typical curve of internal pressure in kilograms per square centimeter as a function of the change in radius divided by the initial radius was shown for two cycles on each of two samples. In medium carbon/steel tubing 37mm outside diameter and 25 mm inside diameter (i.e. ration 1.48) the rupture pressure was 2770 $kg/cm^2$.

(b) Study of shock waves in solids by X-ray photographs.

The study of shock waves from detonations is done by using two X-ray tubes positioned at right angles to one another with both aimed at region where the detonation occurs. The X-ray tubes are pulsed and synchronized - or the delay between either one and the other may be 5 to 500 microseconds. The film in each case faces the tubes so that the two film plates are also at right angles. The pulsing on

the tubes is 1 per sec with 3000 amperes and 70 to 100 kilovolts -- cold cathode tubes of the Westinghouse type with 3 electrodes and continuously pumped. The windows are plastic. The resulting pictures are extremely interesting - the detonator is inside a block of T.N.T., and one can see the waves travelling out from the detonator toward the sides of the TNT block - it looked as though the TNT explosion started after the shock wave was reflected from the side walls of the TNT. There were pictures taken at all stages of the explosion. It may be that copies of these pictures can be obtained.

(c) Studying Plastic Behavior of Rods (Copper) While Being Pulled Apart at High Speed.

Another phase of the work at the institute was that of studying a rod of copper pulled apart by an explosive. The rod in question is marked with circular rings equally spaced along the rod perhaps a quarter of an inch apart. When the rod is pulled apart by the detonation of an explosive the process is followed by a high speed movie camera having a film speed of 3000 meters per second. There is also recorded on a scope the pressure-time relation (in the elastic range) using strain gauges. The high speed movie shows the way in which the ring spacing changes as a function of time in various parts of the rod. One can, by plotting the elongation of the various segments, determine when the material in various segments goes from elastic into plastic behavior. The high pressure work on steel tubes is being supported by Belgian steel manufacturers and the shock wave work is supported by explosive manufacturers.